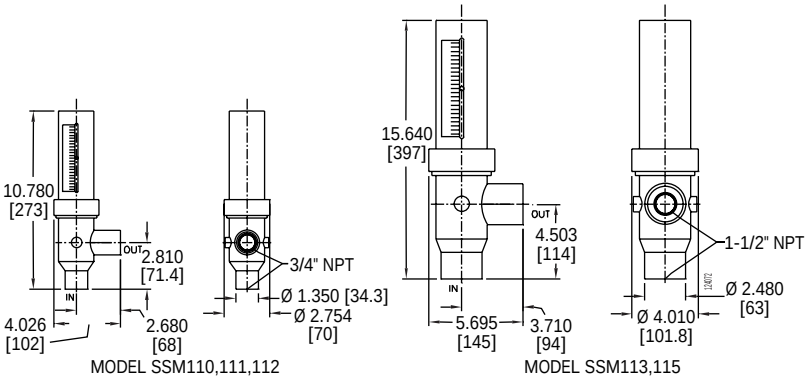
Series SSM & SSB All Metal Flowmeters

Specifications - Installation and Operating Instructions



Series SSM 316 & SSB All Metal Flowmeters are ideal for dirty or opaque fluids, high temperature and high pressure service and harsh environments. The direct reading scale provides ±2% accuracy. Flowmeters can quickly be disassembled without removing the body from the pipeline for easy cleaning.

SAFETY PRECAUTIONS

Personnel safety should be considered before pressurizing and operating the system. There are numerous possibilities for error in system operation and maintenance as well as component installation. Because human eyes must necessarily come into close proximity with the flowmeter to read it, Dwyer Instruments, Inc. recommends that safety shielding such as a sheet of transparent, high impact material be used in front of the meter. If hazardous, toxic, or flammable fluids are being metered, recommended safeguard should include methods to protect personnel from splash or rebound. A method of quick, safe removal of dangerous fluids should also be included.

INSTALLATION

PREPARATION: Series SSM & SSB All Metal Flowmeters are ready to install as-is, although the sight tube may need repositioning so the scale is visible after installation. First, remove the protective caps from the connection ports. ALSO, REMOVE THE PLASTIC TUBING ABOVE THE INLET CAP IN THE METER CORE TUBE! This tubing blocks the float assembly in place during shipment. Check that the float moves freely within the core tube, and that no packing materials are in the meter.

RECOMMENDED PIPING

Series SSM & SSB All Metal Flowmeters generally have no special straight run or other piping requirements. Inlet piping should be the same size as the meter connection. Some effect on meter accuracy may occur at high flow velocities if inlet piping guidelines are violated. Please refer to the table on the next page. When installing on different size pipe, use standard pipe adapters and come into the meter inlet with a nipple 8 diameters long of the same size for greatest accuracy. Control valves should be mounted on the outlet side of the meter. The use of a three valve manifold around the meter is suggested, as it allows uninterrupted process flow while the meter is being cleaned.

PLUMBING-IN

While the flowmeters should be vertical, exact plumbness is not necessary. A general rule is that if the meter appears plumb, it is close enough (even if off by 10º, the predictable reading error is usually less than 1%). Pipe should be cut to proper lengths to avoid stress on the meter. Avoid over-tightening, and do no use wrenches on the body or sight tube. If using solvents in the vicinity of polysulfone sight tubes, the tube should be removed until fumes clear.

SPECIFICATIONS

Service: Compatible liquids.
Wetted Material: T316 SS, Alnico magnet, FKM O-ring.
Temperature Limits: 300ºF (149ºC), temperatures from 300˚F to 600°F (149˚C to 316°C) require “hot top” sold separately.
Pressure Limits: 3/4” models: 1000 psig (68.9 bar) @ 250ºF (121ºC), 1-1/2”models: 800 psig (55 bar) @250ºF (121ºC).
(See the chart on pg. 6 for temperature vs.. pressure ratings.)
Accuracy: ±2% full scale.
Repeatability: ±0.5% of indicated flow rate.
Process Connections: 3/4” or 1-1/2” female NPT.
Scale Length: 3/4” models: 3.2” (8 cm); 1-1/2” models: 5.2” (13 cm).
Weight: 3/4” models: 5 lb (2.3 kg); 1-1/2” models: 13 lb (5.9 kg).

SURGE & WATER HAMMER PREVENTION

Operating Limits are for non-shock conditions only. Flowmeters are more accurate and less likely to be damaged when the fluid flow is smooth. Water hammer is a hazardous phenomenon and should be eliminated from any fluid system. Water hammer is a series of pressure shocks create by a sudden change in the flow velocity of liquid in a pipe. This sudden change, often caused by a fast acting valve or starting, stopping, or change in speed of a pump, generates an immediate rise in pressure that sometimes makes a noise similar to striking the pipe with a hammer. The pressure wave is transmitted from the source throughout the system, subjecting every component to the sudden shock. Pressure returns to normal only when a larger vessel or pipe section is reached, the energy dissipated thru friction and pipe expansion, or some component ruptures. Rupture of piping, valves, flowmeters, or other components have obvious safety ramifications that must be addressed.

Surge Chambers & Accumulators: Flowmeters are more accurate and less likely to be damaged when the fluid flow is smooth. If the meter must be installed on a line where reciprocating pumps causing pulsation are used, surge chambers, accumulators, or desurgers are strongly suggested to dampen the shock wave. This is a good, general practice for all flowmeters.

SIGHT TUBE ROTATION: Series SSM & SSB All Metal Flowmeters use magnetically-linked ball indicators and the scale usually may be positioned over approximately a 300˚ range. However, the magnet position must also be changed accordingly, requiring removal of the sight tube (see “Disassembly”). On standard SSM & SSB All Metal Flowmeters as

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depicted in Figure 1, the magnet slides out of the carrier at the top of the float assembly. The screw holding the carrier to the float may be loosened to allow rotation of the carrier toward the desired scale location. Re-tighten the screw (thread sealant is recommended), replace magnet, and reassemble the meter (see "Assembly"). Verify that the ball indicator has been "captured" by the magnet. If not, rotate the sight tube (DO NOT twist on the edges of the plastic raceway assembly) until the ball is "grabbed" by the float magnet.

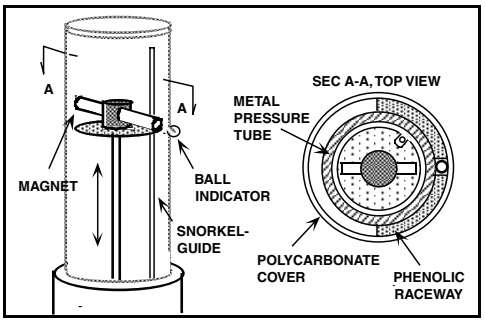


FIGURE 1

STARTUP: System flow should be started with the bypass valve open and meter inlet and outlet valves closed. After the system is operating, open the meter inlet valve gradually to equalize internal pressure. Then slowly crack meter outlet valve and wait for float to stabilize. Finally, slowly open the meter outlet and/or flow regulating valve all the way and close the system by-pass valve. AVOID SUDDEN SURGES THAT CAUSE THE METER FLOAT TO SLAM INTO THE TOP OF THE SIGHT TUBE! Although not essential, the meter sight tube should be filled to a level above the float on liquid systems. The snorkel tube (present in most standard models) allows escape of entrapped gases except for a small pocket in the upper end which helps cushion hydraulic shock. To assure proper filling and to flush any foreign particles from the meter, operate the system at full flow briefly at startup.

READING FLOW

Read flow directly from the scale as the number nearest to the center of the ball indicator.

COMPENSATING FOR SYSTEM CHANGES

To find the correct flow reading for a system whose fluid conditions vary from those for which the meter is scaled, use the conversion equations provided. The most practical method of applying the formulae is to calculate a conversion factor for the new system condition and multiplying the scale reading by that factor. In the problems to the right, "Q's" has been assigned a value of "1" to determine the conversion factor. (Dwyer Instruments, Inc. can provide special scales at additional cost for other fluids and/or units.)

CAUTION: DO NOT OPERATE THE FLOWMETER ON A SYSTEM EXCEEDING THE OPERATING LIMITS OF THE UNIT. WHEN CHANGING OPERATING CONDITIONS, MAKE SURE THAT THE NEW SYSTEM CONDITIONS ARE WITHIN THE FLOWMETER OPERATING LIMITS, AND ALL WETTED MATERIALS ARE COMPATIBLE WITH THE FLUID.

CORRECTING READINGS FOR NEW LIQUID CONDITIONS

$$Q_a = Q_s \sqrt{\frac{Ps(Pf-Pa)}{Pa(Pf-Ps)}} \quad \text{or} \quad Q_a = Q_s \sqrt{\frac{ds(df-da)}{da(df-ds)}}$$

Where:
Qa=Actual flow, GPM (or same units as scale)
Qs=Meter reading from scale, (scale units)
ps=Specific gravity of calibration liquid related to water in std. atmosphere at 70˚F being 1.00
pa=Specific gravity of metered liquid, same base
ds=Density of calibration liquid, lbs/ft3
da=Density of metered liquid, lbs/ft3
pf=Specific gravity of meter float
df=Density of the meter float as per Table below

FLOAT SPECIFIC GRAVITIES/DENSITIES

Material	pf	df
Stainless Steel	8.05	501.1
Brass	8.30	516.6

EXAMPLE: Using a standard brass meter scaled for water (ps = 1.00), what is the conversion factor for an oil with a specific gravity of 0.85?

$$Q_a = 1.00 \times \sqrt{\frac{1.00\ (8.30-0.85)}{0.85\ (8.30-1.00)}} = 1.096$$

Thus, actual flow of the oil would be the observed scale reading times 1.096.

MAXIMUM FLOWS (WITHOUT EFFECTING ACCURACY)
FOR UNDERSIZED PIPES CONNECTED DIRECTLY TO FLOWMETER INLETS

PIPE NPS	DATA (ID)²	MAX. * GPM LIQ.	MAX. SCFM AIR @ †			
			ATMOS.	50 PSIG	100 PSIG	200 PSIG
1/4	0.132	1.72	0.864	3.80	6.74	12.6
3/8	0.243	2.98	1.59	7.00	12.4	23.2
1/2	0.387	4.74	2.53	11.1	19.8	37.2
3/4	0.679	8.31	4.44	19.5	34.7	64.9
1	1.100	13.47	7.20	31.7	56.1	105
1-1/4	1.904	23.32	12.5	58.8	97.2	182
1-1/2	2.592	31.74	17.0	74.6	132	248
2	4.272	52.29	28.0	123	218	408
2-1/2	6.096	74.56	39.9	176	311	582
3	9.413	115.2	61.6	271	480	804

* Data per *Cameron Hydraulic Data.* Based on 5 FPS max. liquid velocity having no effect on flowmeters accuracy if the inlet pipe is smaller than the meter connections.

† SCFM=0.445 x (psig + 14.7) x $(ID)^2$. Based on 20 FPS max. air velocity having no effect on flowmeters accuracy if the inlet pipe is smaller than the meter connections.

CORRECTING READINGS FOR NEW GAS CONDITIONS

$$Q_g = Q_s \sqrt{\frac{P_g \times T_s \times P_s}{P_s \times T_g \times P_g}}$$

Where:

Q_g=SCFM, corrected to new conditions

Q_s=SCFM read on meter scale

P_g=Operating pressure, psia (psig + 14.7)

Q_s=Pressure stated on scale, psia (psig + 14.7)

T_g=Operating temperature, absolute (°F +460)

T_s=Temperature stated on scale, absolute (°F + 460)

P_g=Specific gravity of metered gas

P_s=Specific gravity stated on scale

EXAMPLE: If using a standard meter scaled for SCFM Dry Air @ 100 psig, 70°F on argon (SP. GR.=1.378) at 50 psig, 100°., what would the conversion factor be?

$$Q_a = 1.00 \sqrt{\frac{64.7 \times 1.00 \times 530}{114.7 \times 1.378 \times 560}} = 0.622$$

Thus, actual flow of the argon would be the observed scale reading times 0.622.

STEAM

Series SSM & SSB gas flowmeters may be used for vapors such as steam. The conversion factor may be determined with the following formula:

$$M_{fh} = Q_m \frac{5.879}{\sqrt{S_v}}$$

Where:

M_{fh}=Actual flow, lbs/hr.

Q_m=Meter scale reading, Std. (SCFM Dry Air @ 100 psig, 70°F)

S_v=Specific volume of media (from steam table)

EXAMPLE: When using a standard gas meter scaled from SCFM Dry Air @ 100 psig, 70°F, what is the conversion factor for lbs/hr. steam at 50 psig, 300°F?

$$M_{fh} = \frac{5.879}{\sqrt{6.727}}$$

Thus, actual flow of steam in lbs/hr. would be the observed scale reading times 2.267.

VISCOSITY CONSIDERATIONS

Each liquid flowmeter has so-called “Viscosity Immunity Ceiling” (V.I.C.). Usually, if the viscosity of the metered liquid is less than the V.I.C., the meter will be influenced significantly, and must be calibrated for that viscosity. Effects of viscosity on a given flowmeter are not always predictable. Two apparently similar liquids with comparable densities and viscosities may impact meter calibrations quite differently. The table below provides **general guidelines** for the typical maximum viscosity for meter models without affecting accuracy.

AVERAGE V.I.C., CENTISTOKES, FOR STANDARD “THRU VIEW” FLOWMETERS

100% GPM, 3/4” METERS	CTS	100% GPM, 1-1/2” METERS	CTS
0.54-0.80	0.54-0.80	0.54-0.80	0.54-0.80
1.20-2.60	1.20-2.60	1.20-2.60	1.20-2.60
3.80-7.00	3.80-7.00	3.80-7.00	3.80-7.00
10.0-23.0	10.0-23.0	10.0-23.0	10.0-23.0

MAINTENANCE

Upon final installation of the Series SSM & SSB All Metal Flowmeters, no routine maintenance is required. A periodic check of the system calibration is recommended. The Series SSM & SSB All Metal Flowmeters are not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

METER DISASSEMBLY

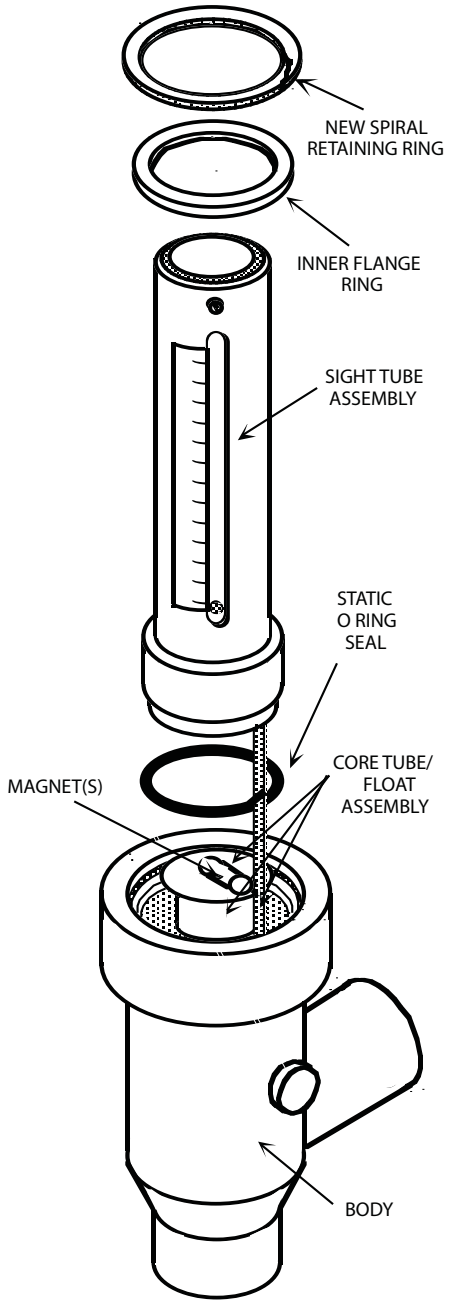


FIGURE 2: PARTIALLY EXPLODED DRAWING OF SERIES SSM & SSB ALL METAL FLOWMETERS

It is not necessary to remove the flowmeters from the pipeline for cleaning or replacing parts. The body remains plumbed into the pipe, allowing easy service and even installation of the different sensing elements to accommodate new flow rates or fluids. Figure 2 shows some of the major components. Step by step disassembly and reassembly instructions and photos are included in the following.

CAUTION: BE SURE PRESSURE IS FULLY VENTED AND FLUIDS COMPLETELY DRAINED BEFORE DISASSEMBLING THE FLOWMETER. DISCONNECT POWER TO ELECTRONIC ACCESSORIES. WEAR SAFTEY GLASSES AND PROTECTIVE CLOTHING IF THERE IS A CHANCE OF EXPOSURE TO HAZARDOUS FLUIDS!

1. Remove the raceway cover by removing the stainless screw at the top, and lift it up and off the meter. Remove the black phenolic raceway, being careful not to displace the ball indicator. Remove the ball indicator by hand, and set it where it will not be lost.

2. Using a screwdriver, carefully pry the notched end of the spiral retaining ring out of the body groove. Move the screwdriver blade under the ring- the action is very much like putting a key on a key ring. Continue until the entire spiral ring has been removed from the groove (please see the photo below).

3. Using hands only, pull the sight tube straight up out of the body with a slight twisting motion, lifting it clear of the body and snorkel. The inner flange ring will lift off with the sight tube.

4. Remove the float assembly by lifting it up and away from the snorkel. The core tube assembly may then be lifted out. If stuck, CAREFULLY pry at the top of the slot with a brass rod, taking care not to damage the body or core tube. The spider ring and O-ring will come out with the core tube. If the core tube is stuck, try removing the metal spider ring first (please see the photo below).

INSPECTION & CLEANING

Inspect parts for nicks, scratches, chips, wear, and contaminant build-up. The edges of the core tube slot, ID of the core tube and OD of the piston (largest section at the float assembly bottom) are precision machined. Damage to these areas can destroy the meter's accuracy. Also inspect the O-ring, the bottom section of the sight tube, and the inside of the upper body section. Damage to these areas may result in leaking. Clean, rinse, and dry all parts carefully, including the O-ring, preferably with a mild detergent and water and a soft cloth or soft tube brush. If solvents are used, make sure they are compatible with meter parts.

CAUTION: DO NOT SCRAPE OR USE ABRASIVE MATERIALS FOR CLEANING!!!

FLOWMETER ASSEMBLY

In general, replace all parts in reverse order of the disassembly.

1. Place the slotted meter tube into the body, aligning the “key” at the bottom of the tube with the keyslot in the bottom of the body.

2. Place the spider over the meter tube with the “notched leg over the snorkel tube or guide rod. Slide the spider down to the meter tube’s shoulder.

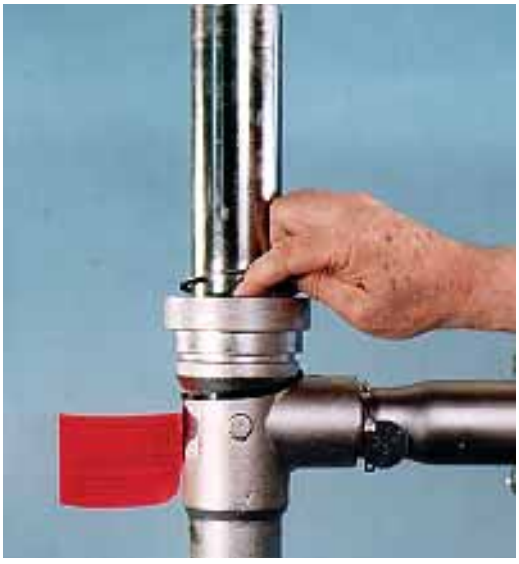
3. Place the meter float in the meter tube, aligning the notch in the indicator disk with the snorkel.

4. Seat the O-ring on the sight tube, lubricating it with a small amount of service-compatible silicone grease or petroleum jelly to facilitate replacement.

5. Using hands only, press the sight tube firmly down into the meter body with a twisting motion. Be careful not to rock the sight tube side to side and bend the snorkel tube/guide inward where it might interfere with float movement. Rotate sight tube as necessary for scale visibility and/or alignment of the raceway screw.

6. Slide the inner flange ring over the sight tube. When properly seated, the top of the flange ring should be flush with the bottom edge of the snap ring groove.

7. Separate the coils of the spiral retaining ring, and insert one end into the body groove. Wind the ring into the groove, making sure the ring is properly seated. Then replace the ball indicator (the tip of a screwdriver can be used to help locate the magnet), and replace the raceway and raceway cover.



If reassembled correctly, the center of the ball indicator should lineup with the scale “zero” (either dotted black or scribed line). If it does not, disassemble the meter completely and carefully reassemble it, making sure the slotted meter tube is completely seated in the body.

If new flow internals are used, the scale may have to be remounted on the sight tube. Depending on the model type, this can be done either by loosening the mounting screw, or reattaching the scale with double sided adhesive (new flow internals are shipped with a new scale).

REPLACEMENT PARTS

Under proper care, there should be no need to stock replacement parts. If the service or environment is quite harsh, or frequent meter disassembly dictated, a spare O-ring may be desirable.

Otherwise, parts only need to be replaced if damaged. Any visible damage to the entire surface of the O-ring or sight tube (particularly from the bottom edge) indicates need for replacement. To insure accuracy, the inside surface of the meter core tube, slot edges, and OD of the float piston should be free of nicks, chips, with no visible erosion of any surfaces. If abrasive particles are suspended in the meter fluid, it may be desirable to keep replacement core tube/float assemblies on hand (Dwyer Instruments, Inc. may also be able to recommend a more abrasive-resistant construction).

To order parts, include the model and serial number of the units involved, and description of the part ordered. If converting the meter to a new application, in addition to the model and serial numbers, SEND DWYER INSTRUMENTS, INC. COMPLETE APPLICATION DATA INCLUDING FLUID, MAXIMUM FLOW RATE, MAXIMUM AND OPERATING PRESSURES AND TEMPERATURES, AND APPLICATION PARTICULARS OR FLUID CHARACTERISTICS. This information is essential for Dwyer Instruments, Inc. to provide proper items, and verify that the new application is within the operating limits of the flowmeter.

TEMPERATURE VS. PRESSURE, OPERATING LIMITS, "SERIES SSM & SSB" ALL METAL FLOWMETERS*

METER SIZE & MATERIAL	MAXIMUM NON-SHOCK WORKING PRESSURE, PSIG @ °F							
	0°F	70°F	300°F †	350°F †	400°F †	450°F †	500°F †	600°F †
6 (3/4" NPT)-Stainless	1000	1000	1000	990	970	950	930	900
12 (1-1/2" NPT)-Stainless	800	800	800	790	780	770	760	750

* OPERATING LIMITS GIVEN ARE BASED ON WATER OR AIR. FOR MORE SEVERE SERVICE, CORROSIVE, AND OTHER MEDIA AND/OR ENVIRONMENTAL FACTORS, AN ADDITIONAL CORRECTION FACTOR DOWN-RATING THESE LIMITS MAY BE REQUIRED. LIMITS ARE BASED ON TESTING AND PRACTICAL EXPERIENCE. POSSIBLE EXTREME APPLICATIONS CONDITIONS CANNOT BE FORESEEN. THUS, DATA OFFERED ONLY AS A GUIDE. IT IN NO WAY CONSTITUTES A SPECIFIC RECOMMENDATION OR WARRANTY EXPRESSED OR IMPLIED.

† OPERATING TEMPERATURES ABOVE 300°F REQUIRE SPECIAL HIGH TEMPERATURE MODIFICATIONS.

TROUBLESHOOTING

SYMPTOM	USUAL CAUSE	SUGGESTED REMEDY
FLOAT HANG-UP:	Caused by particles, sludge, etc. (including failure to remove the plastic tubing used to block meter float during shipment) inside the core tube and/or sight tube holding float. A bent snorkel tube/guide rod (usually caused by careless disassembly or violent surges) may also be causing float to stick. Violent surges may also unseat the internals in extreme cases.	Remedies include tapping the meter gently to temporarily dislodge the float, but if problem reoccurs, meter should be disassembled & cleaned, and/or snorkel/guide rod straightened. If hang-up caused by sludge or pipe scale, clean lines & install a filter or other form of cleaner in supply line. If surges have caused the internals to unseat, install a desurger, accumulator, etc.
FLOAT BOUNCE:	Caused by pumping/compressor surges or other pulsation sources, loose valve disks or similar mechanical components, extreme violation of inlet piping recommendations, or for gas applications, harmonics commonly found in systems with low pressure, low density gas.	Modification of piping, such as addition of a desurger, receiver, accumulator, vibration eliminators, loops, hoses, etc. between the source and meter should remedy the problem. Severe vibration may ultimately damage the meter, and should be avoided. If "bounce" seems to be from some other source, or shocks such as "water hammer" (a potentially dangerous condition), discontinue using the meter and contact Dwyer Instruments, Inc.
LOSS OF BALL INDICATOR:	Caused either by rotating the sight tube without realigning the float magnet, or sudden flow surges or shocks.	Check the ball alignment to magnet by removing the raceway cover and using the tip of a small screwdriver to locate the float magnet. Rotate the sight tube as required, and replace raceway (or disassemble meter to change magnet position if required). If the alignment is okay, eliminate system shock or surges with desurgers or accummulators.
APPARENT FALSE READINGS, LIQUID METERS:	Liquid density not according to calibration data (differ temperature or new liquid or liquid mixture), excessive dissolved or suspended solids or gases, partial clogging of core tube slot or foreign matter interfering with float movement, or viscosity levels above the meter's immunity index (V.I.C.) NOTE: If the meter is suspected of giving false readings, and none of the causes mentioned is found, please advise Dwyer Instruments, Inc. as to the method used in determining the suspected flow "error". Each Flowmeter is individually calibrated by traceable methods, and carefully inspected. There may be some error in checking the meter against another standard.	By determining the actual density (due to changes in mixture, temperature, etc.), the correction formulae may be applied. If dissolved gases are in the liquid, some elimination means should be provided on the supply side (also recheck all piping, as improper seals at connection points are common sources of air in the liquid). If the metered liquid is near the boiling point producing partial "flash gas" at the meter, relocate the meter to point of lower temperature and/or higher pressure, or cool lines and/or increase system pressure. Note: It is potentially dangerous to meter near the "flash point" of any fluid, and this practice should be avoided. Consult Dwyer Instruments, Inc. for recommendations. The previous recommendations regarding cleaning the meter and/or filtration will also solve problems due to dirt. If metering liquids with high viscosities, consult Dwyer Instruments, Inc. (may require special calibration). If none of these causes seem to be present, contact Dwyer Instruments, Inc. for assistance.
APPARENT METER READING MIGRATION (reading changes but flow appears constant):	Frequently caused by use of soft disc type valves, which may need to be replaced with a valve more suited to flow control. Can also be indicative of changing fluid conditions (density, viscosity, etc.). Problems with other elements of the flow system, including leaks, clogged filters, pump/compressor wear, etc. may first appear as a change in meter reading-one of the functions of a flowmeter.	Verifying the proper fluid conditions are known and applying correction formulae as needed will remedy problems associated with changing fluids. Cleaning, servicing, and replacement and/or repair of other system components may be required.
LEAKAGE:	If at the junction of the body and sight tube, it is indicative of either (a) damaged O-ring (most common); (b) damaged sight tube; or (c) damage to the gland section of the body. It may also be caused by improper reassembly of the flowmeter in the field. If there is leakage at the pipe connections to the meter, it is probably caused from over-tightening pipes on a prior installation (or the initial installation).	Replace any damaged parts immediately, using the proper assembly procedures indicated in this instruction and the assembly detail drawings. Remove the body and inspect for damage-if none is visible, check pipe threads, reapply proper thread lubricant/sealant, and reinstall. If leak persists, replace meter body.

NOTE: Flowmeters are hydrostatically pressure tested before they are shipped. Dwyer Instruments, Inc. encourages you to contact your Dwyer Instruments, Inc. representative or the factory with any questions regarding proper installation and operation of our flowmeters.

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